

**CORRECTED
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PCT

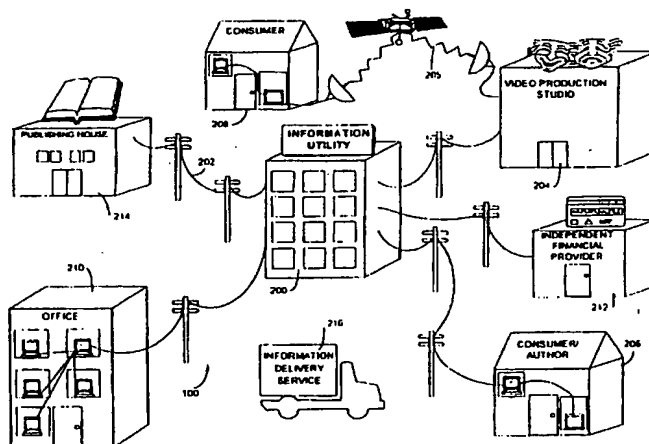
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International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G06F 1/00, 17/60	A3	(11) International Publication Number: WO 96/27155 (43) International Publication Date: 6 September 1996 (06.09.96)
(21) International Application Number: PCT/US96/02303 (22) International Filing Date: 13 February 1996 (13.02.96) (30) Priority Data: 08/388,107 13 February 1995 (13.02.95) US (71) Applicant: ELECTRONIC PUBLISHING RESOURCES, INC. [US/US]; 5203 Battery Lane, Bethesda, MD 20814 (US). (72) Inventors: GINTER, Karl, L.; 10404 43rd Avenue, Beltsville, MD 20705 (US). SHEAR, Victor, H.; 5203 Battery Lane, Bethesda, MD 20814 (US). SPAHN, Francis, J.; 2410 Edwards Avenue, El Cerrito, CA 94530 (US). VAN WIE, David, M.; 1250 Lakeside Drive, Sunnyvale, CA 94086 (US). (74) Agent: FARIS, Robert, W.; Nixon & Vanderhye P.C., 1100 North Glebe Road, Arlington, VA 22201-4714 (US).		(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AZ, BY, KG, KZ, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 19 June 1997 (19.06.97)

(54) Title: SYSTEMS AND METHODS FOR SECURE TRANSACTION MANAGEMENT AND ELECTRONIC RIGHTS PROTECTION



(57) Abstract

The present invention provides systems and methods for electronic commerce including secure transaction management and electronic rights protection. Electronic appliances such as computers employed in accordance with the present invention help to ensure that information is accessed and used only in authorized ways, and maintain the integrity, availability, and/or confidentiality of the information. Secure subsystems used with such electronic appliances provide a distributed virtual distribution environment (VDE) that may enforce a secure chain of handling and control, for example, to control and/or meter or otherwise monitor use of electronically stored or disseminated information. Such a virtual distribution environment may be used to protect rights of various participants in electronic commerce and other electronic or electronic-facilitated transactions. Secure distributed and other operating system environments and architectures, employing, for example, secure semiconductor processing arrangements that may establish secure, protected environments at each node. These techniques may be used to support an end-to-end electronic information distribution capability that may be used, for example, utilizing the "electronic highway".

* (Referred to in PCT Gazette No. 52/1996, Section II)

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 96/02303

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06F1/00 G06F17/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- *A* document member of the same patent family

Date of the actual completion of the international search

18 April 1997

Date of mailing of the international search report

14. 05. 97

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Powell, D

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 96/02303

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 90 02382 A (INDATA CORP) 8 March 1990	1,2,5,6, 23,24, 62-65, 68,69, 72-77, 99-102, 133-138, 147-152, 155-158, 199,200
Y	see abstract; figures 2,15 see page 18, last paragraph - page 21, paragraph 2	21,22, 29,30, 103-108, 127-130, 223,224, 233,234, 237,238, 241-244, 504,506
A	see page 23, last paragraph - page 24, paragraph 1	61,143, 144,207, 208,245, 246, 487-500, 507-509

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INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/US 96/02303

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 319 705 A (HALTER BERNARD J ET AL) 7 June 1994	7-12, 17-20, 72-77, 133,134, 147-152, 155-158, 265-268, 298,300, 363,396
Y	see abstract; figures 2,4,12	21,22, 109,110, 115, 203-206, 213,214, 223,224, 237,238, 265, 302-305, 394,395
A	see column 4, line 33 - column 6, line 24 see column 24, line 33 - column 25, line 13	25,26, 31-38, 127-132, 207,208, 370-374, 381-384, 404

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INTERNATIONAL SEARCH REPORT

Internat. Application No
PCT/US 96/02303

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	TRANSACTIONS OF THE INSTITUTE OF ELECTRONICS, INFORMATION AND COMMUNICATION ENGINEERS OF JAPAN, vol. E73, no. 7, July 1990, TOKYO, JP, pages 1133-1146, XP000159229 R.MORI ET AL: "Superdistribution: The Concept and the Architecture"	72-77, 99-102, 127-134
Y		29,30, 103-108, 127-130, 233,234, 241-244, 504,506
A	see abstract; figure 1 see page 1134, left-hand column, line 25 - page 1135, right-hand column, line 27	31-38, 153,154, 219,220, 231,232, 370-374, 381-384, 494-497, 501-503, 511,512
X	--- EP 0 128 672 A (GALE IRA DENNIS) 19 December 1984 see abstract; figure 1 see page 11, line 1 - line 18	78,79, 139-142
A		80,81, 197,525
X	--- US 4 672 572 A (ALSBERG PETER) 9 June 1987 see abstract; figures 1,2,5,8	83,84
Y		109,110, 115, 302-305, 394,395
A	see column 2, line 9 - column 3, line 26	245,246, 253,254
Y	--- EP 0 565 314 A (FISCHER ADDISON M) 13 October 1993 see abstract --- -/--	243,265

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 96/02303

C(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 799 156 A (SHAVIT EYAL ET AL) 17 January 1989	42-44, 203-206, 213,214
A	see abstract; figure 2 see column 7, line 47 - column 8, line 54 see column 9, line 7 - column 11, line 35	153,154, 207,208, 225-228, 370-374, 381-384, 494-497, 501-503
Y	--- MAPPING NEW APPLICATIONS ONTO NEW TECHNOLOGIES, ZURICH, MAR. 8 - 10, 1988, no. -, 8 March 1988, PLATTNER B;GUNZBURGER P, pages 45-52, XP000215989 SIUDA K: "SECURITY SERVICES IN TELECOMMUNICATIONS NETWORKS" see the whole document	42-44
A		31-38, 55-58, 95,153, 154,231, 232
Y	--- EP 0 399 822 A (HEWLETT PACKARD CO) 28 November 1990 see the whole document	87-89
Y	--- GB 2 264 796 A (IBM) 8 September 1993 see the whole document	87-89
A	--- WO 92 22870 A (ICL DATA AB) 23 December 1992	93-98, 277-280, 306-318, 342-349, 375-379, 385, 387-393
	see the whole document	
A	--- US 5 343 527 A (MOORE JAMES W) 30 August 1994	93-98, 277-280, 306-318, 342-349, 375-379, 385, 387-393
	see the whole document	

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 96/02303

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 421 409 A (IBM) 10 April 1991 see the whole document ---	225-228, 245,246, 253,254
A	US 5 103 476 A (WAITE DAVID P ET AL) 7 April 1992 see the whole document ---	319, 321-340
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A	US 4 823 264 A (DEMING GILBERT R) 18 April 1989 ---	
A	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 37, no. 3, 1 March 1994, pages 413-417, XP000441522 "MULTIMEDIA MIXED OBJECT ENVELOPES SUPPORTING A GRADUATED FEE SCHEME VIA ENCRYPTION" ---	
A	US 5 224 163 A (GASSER MORRIE ET AL) 29 June 1993 ---	
A	WO 94 06103 A (HNC INC) 17 March 1994 ---	
A	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 37, no. 4B, 1 April 1994, pages 523-525, XP000451335 "TRANSFORMER RULES STRATEGY FOR SOFTWARE DISTRIBUTION MECHANISM-SUPPORT PRODUCTS" ---	
A	WO 94 03859 A (INT STANDARD ELECTRIC CORP) 17 February 1994 -----	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 96/ 02303

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see annexed sheets.

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

Inventions: 3, 6,7,9,10,24 and 29
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US 96/ 02303

FURTHER INFORMATION CONTINUED FROM PCT/SAJ/210

The following (groups of) inventions have been identified:

Invention	Claims	Subject matter
1.	1-12,17-26,29,30,61-65,68,69,72-77,99-108,127-130,133-138,147-152,155-158,199,200,219-222,233,234,243,244,265-268,294-301,363,364,396,404,504,505	Solving problems related to: Distributing electronic information to a rightful destination using a different virtual distribution environment node (than either supplier or destination) to process the control information associated with the said digital information (cf. either of documents D1 and D2)
2.	13-16	Solving problems related to: Automating electronic processes.
3.	31-39,42-45,55-58,153,154,203-208,213-218,223-228,231,232,237,238,241,242,370-374,381-384,487-489,500,505,507-512	Solving problems related to: Electronic commerce.
4.	40,41,46-54,259-262,402	Solving problems related to: Identification of principals or principals' properties.
5.	59,60,66,67,70,71,235,236,239,240,401	Solving problems related to: Handling electronic currency.
6.	78-81,139-144,197,525	Solving problems related to: Tamper-resistant containers.
7.	82-84,109-116,127-132,273-276,302-305,394,395,494-497,501-503	Solving problems related to: Audit or administrative information.
8.	85,86	Solving problems related to: Human readable interfaces.
9.	87-92,201,202,209,210,282,283	Solving problems related to: Event or task processing.
10.	93-98,277-280,306-318,342-349,375-379,385,387-393	Solving problems related to: Checking component integrity or validity.
11.	117-122	Solving problems related to: Compromising a security system.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US 96/ 02303

FURTHER INFORMATION CONTINUED FROM PCT/ISA/210

- | | | |
|-----|---|---|
| 12. | 123-126 | Solving problems related to:
Electronic data fingerprinting. |
| 13. | 159,160,194-196,400,516,
523,524 | Solving problems related to:
Secure processors. |
| 14. | 161-166,517 | Solving problems related to:
Video controllers. |
| 15. | 167-172,175,176,518,519 | Solving problems related to:
Network communications. |
| 16. | 173,174,520 | Solving problems related to:
CD-ROM controllers. |
| 17. | 177,178,521 | Solving problems related to:
Set-top controllers. |
| 18. | 179-185,522 | Solving problems related to:
Electronic games. |
| 19. | 188-193 | Solving problems related to:
Multimedia communications. |
| 20. | 198,526 | Solving problems related to:
Detection of power supply interruption. |
| 21. | 145,146 | Solving problems related to:
Bitmap data structures. |
| 22. | 211,212 | Solving problems related to:
Modular control structures. |
| 23. | 229,230 | Solving problems related to:
Billing and budgeting. |
| 24. | 245,248,253,254,341,
350-353,360-362 | Solving problems related to:
Protected processing operations. |
| 25. | 27,28,247-252,513-515 | Solving problems related to:
Secure database management. |
| 26. | 263,264 | Solving problems related to:
Secure electronic mail. |
| 27. | 269-272 | Solving problems related to:
Controlling a robot. |

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US 96/ 02303

FURTHER INFORMATION CONTINUED FROM PCT/ISA/210

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|-----|-------------------------|--|
| 28. | 284-293,482-486 | Solving problems related to:
Business automation. |
| 29. | 318,321-340 | Solving problems related to:
Software construction. |
| 30. | 320,369,380 | Solving problems related to:
Resource management. |
| 31. | 354-359,365-368 | Solving problems related to:
Combining or modifying data. |
| 32. | 397 | Solving problems related to:
Point of sale systems. |
| 33. | 398,399,490-493,498,499 | Solving problems related to:
Advertising. |
| 34. | 403 | Solving problems related to:
Renting an appliance. |
| 35. | 255-258,281,386 | Solving problems related to:
Flights described in software. |

A concise analysis shows that the Special Technical Features of these 35 groups of claims, as determined by comparison with the features disclosed in either of documents D1 or D2, are not the same. A comparison of the objective problems related to these different groups of inventions, all seen in the light of the description and the drawings of the application, shows that these objective problems are all different and have no corresponding technical effect.

Consequently, the Special Technical Features of these different groups of inventions are neither the same nor corresponding as defined in Rule 13.2 PCT, 2nd sentence, and therefore the requirement of Unity of Invention (Rule 13.1, 2 PCT) has not been fulfilled.

Finally, it should be noted that searching the additional subject-matter of any of the groups of claims 2-35 would have involved a considerable additional search effort.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 96/02303

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9002382 A	08-03-90	AU 4188289 A EP 0472521 A US 5247575 A	23-03-90 04-03-92 21-09-93
US 5319705 A	07-06-94	JP 7093148 A	07-04-95
EP 0128672 A	19-12-84	WO 8404614 A	22-11-84
US 4672572 A	09-06-87	NONE	
EP 0565314 A	13-10-93	AU 3560793 A CA 2093094 A JP 6295286 A US 5390247 A US 5337360 A	07-10-93 07-10-93 21-10-94 14-02-95 09-08-94
US 4799156 A	17-01-89	CA 1281417 A EP 0370146 A	12-03-91 30-05-90
EP 0399822 A	28-11-90	US 5075847 A JP 3034018 A	24-12-91 14-02-91
GB 2264796 A	08-09-93	EP 0582681 A WO 9318454 A	16-02-94 16-09-93
WO 9222870 A	23-12-92	AU 660997 B AU 2022792 A DE 69203454 D EP 0588898 A ES 2078051 T FI 935541 A JP 6509430 T SE 9200604 A US 5602993 A	13-07-95 12-01-93 17-08-95 30-03-94 01-12-95 10-02-94 20-10-94 13-12-92 11-02-97
US 5343527 A	30-08-94	NONE	
EP 0421409 A	10-04-91	US 5048085 A CA 2026739 A,C JP 3237551 A	10-09-91 07-04-91 23-10-91

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 96/02303

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0421409 A		US 5148481 A	15-09-92
US 5103476 A	07-04-92	CA 2095723 A	08-05-92
		EP 0556305 A	25-08-93
		JP 7089345 B	27-09-95
		JP 6501120 T	27-01-94
		WO 9209160 A	29-05-92
		US 5222134 A	22-06-93
US 5111390 A	05-05-92	NONE	
US 4823264 A	18-04-89	NONE	
US 5224163 A	29-06-93	NONE	
WO 9406103 A	17-03-94	AU 4850093 A	29-03-94
		CA 2144068 A	17-03-94
		EP 0669032 A	30-08-95
		JP 8504284 T	07-05-96
WO 9403859 A	17-02-94	EP 0606401 A	20-07-94
		JP 7502847 T	23-03-95

(discussed below) that are controlled by the VDE nodes of the sender and receiver. As a result, permission records 808 and key blocks 810 will frequently, in the preferred embodiment, be stored only on electronic appliances 600 of registered users (and
5 may themselves be delivered to the user as part of a registration/initialization process). In this instance, permission records 808 and key blocks 810 for each property can be encrypted with a private DES key that is stored only in the secure memory of an SPU 500, making the key blocks unusable
10 on any other user's VDE node. Alternately, the key blocks 810 can be encrypted with the end user's public key, making those key blocks usable only to the SPU 500 that stores the corresponding private key (or other, acceptably secure, encryption/security techniques can be employed).

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In the preferred embodiment, the one or more keys used to encrypt each permission record 808 or other management information record will be changed every time the record is updated (or after a certain one or more events). In this event, the
20 updated record is re-encrypted with new one or more keys. Alternately, one or more of the keys used to encrypt and decrypt management information may be "time aged" keys that

automatically become invalid after a period of time.

Combinations of time aged and other event triggered keys may also be desirable; for example keys may change after a certain number of accesses, and/or after a certain duration of time or absolute point in time. The techniques may also be used together for any given key or combination of keys. The preferred embodiment procedure for constructing time aged keys is a one-way convolution algorithm with input parameters including user and site information as well as a specified portion of the real time value provided by the SPU RTC 528. Other techniques for time aging may also be used, including for example techniques that use only user or site information, absolute points in time, and/or duration of time related to a subset of activities related to using or decrypting VDE secured content or the use of the VDE system.

VDE 100 supports many different types of "objects" 300 having the logical object structure 800 shown in Figure 17. Objects may be classified in one sense based on whether the protection information is bound together with the protected information. For example, a container that is bound by its control(s) to a specific VDE node is called a "stationary object"

will be successful. In this example, matching is determined by validity of decrypted output, not by direct comparison of keys.

Key convolution as described above need not use both site ID and time as a value. Some keys may be generated based on current real time, other keys might be generated on site ID, and still other keys might be generated based on both current real-time and site ID.

Key convolution can be used to provide "time-aged" keys. Such "time-aged" keys provide an automatic mechanism for allowing keys to expire and be replaced by "new" keys. They provide a way to give a user time-limited rights to make time-limited use of an object, or portions of an object, without requiring user re-registration but retaining significant control in the hands of the content provider or administrator. If secure database 610 is sufficiently secure, similar capabilities can be accomplished by checking an expiration date/time associated with a key, but this requires using more storage space for each key or group of keys.

In the preferred embodiment, PERCs 808 can include an expiration date and/or time after which access to the VDE-protected information they correspond to is no longer authorized. Alternatively or in addition, after a duration of time related to

incorporate time as a component, and may be replaced when expired.

Traveling Object Shared Keys

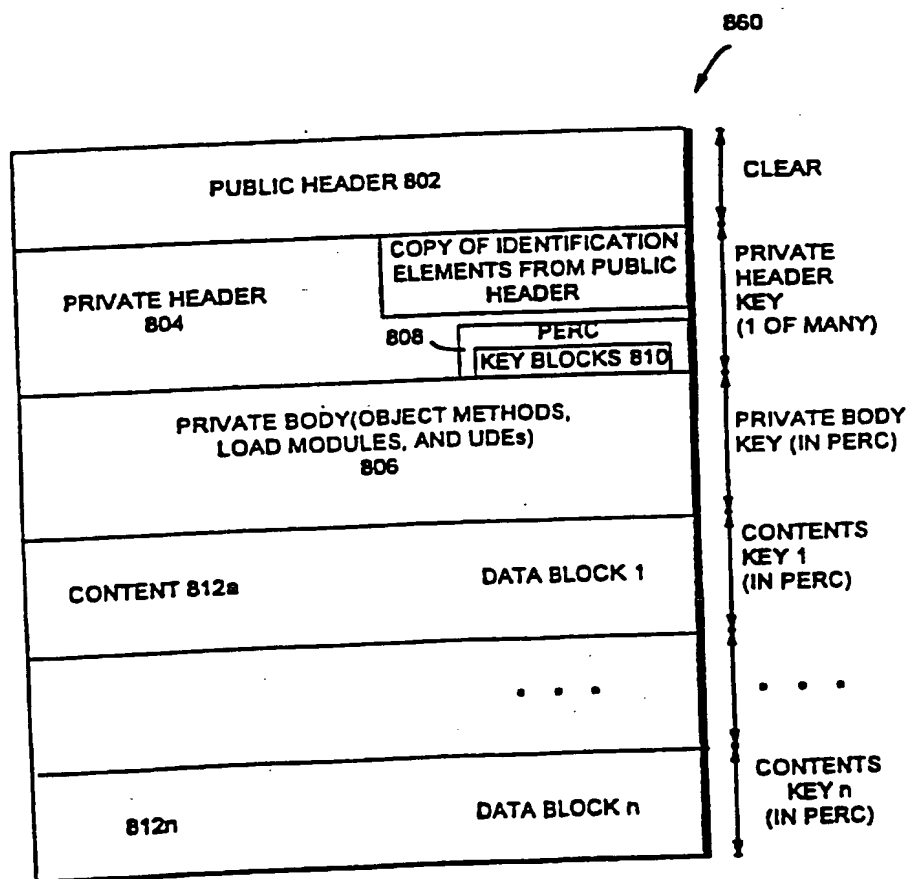
A traveling object shared key may be used to decrypt the private header of traveling objects 860. In the preferred embodiment, traveling objects contain permissions record 808 in their private headers. The permissions record 808 preferably contains the keys for the private body and the keys for the content that can be accessed as permitted by the permissions record 808. These shared keys may incorporate time as a component, and may be replaced when expired.

Secure Database Keys

PPE 650 preferably generates these secure database keys and never exposes them outside of the PPE. They are site-specific in the preferred embodiment, and may be "aged" as described above. As described above, each time an updated record is written to secure database 610, a new key may be used and kept in a key list within the PPE. Periodically (and when the internal list has no more room), the PPE 650 may generate a new key to encrypt new or old records. A group of keys may be used instead of a single key, depending on the size of the secure database 610.

auditors, some one or more who may have the responsibility to "pass along" audit packets to other auditors. In another embodiment, audit information may be passed, for example, to a clearinghouse, which may then redistribute all and/or appropriate subsets of said information (and/or some processed result) to one or more other parties, said redistribution employing VDE secure objects created by said clearinghouse.

An important function of an auditor (receiver of audit information) is to pass administrative events back to a user VDE node in acknowledgement that audit information has been received and/or "recognized." In the preferred embodiment, the receipt and/or acceptance of audit information may be followed by two processes. The first event will cause the audit data at a VDE node which prepared an audit report to be deleted, or compressed into, or added to, one or more summary values. The second event, or set of events, will "inform" the relevant security (for example, termination and/or other consequence) control information (for example, budgets) at said VDE node of the audit receipt, modify expiration dates, provide key updates, and/or etc. In most cases, these events will be sent immediately to a site after an audit trail is received. In some cases, this transmission may be delayed to, for example, first allow processing of the audit trail and/or payment by a user to an auditor or other party.



TRAVELING OBJECT

FIG. 19

management involving event driven VDE activities at both the intended audit information receiver and sender and employing both their secure PPE650 and secure VDE communication techniques.

In the preferred embodiment, each time a user registers a new object with her own VDE node, and/or alternatively, with a remote clearinghouse and/or distributor VDE node, one or more permissions records are provided to, at least in part, govern the use of said object. The permissions records may be provided dynamically during a secure UDE registration process (employing the VDE installation secure subsystem), and/or may be provided following an initial registration and received at some subsequent time, e.g. through one or more separate secure VDE communications, including, for example, the receipt of a physical arrangement containing or otherwise carrying said information. At least one process related to the providing of the one or more permissions records to a user can trigger a metering event which results in audit information being created reflecting the user's VDE node's, clearinghouse's, and/or distributor's permissions records provision process. This metering process may not only record that one or more permissions records have been created. It may also record the VDE node name, user name, associated object identification information, time, date, and/or other identification information. Some or all of this information can

become part of audit information securely reported by a clearinghouse or distributor, for example, to an auditing content creator and/or other content provider. This information can be reconciled by secure VDE applications software at a receiving auditor's site against a user's audit information passed through by said clearinghouse or distributor to said auditor. For each metered one or more permissions records (or set of records) that were created for a certain user (and/or VDE node) to manage use of certain one or more VDE object(s) and/or to manage the creation of VDE object audit reports, it may be desirable that an auditor receive corresponding audit information incorporated into an, at least in part, encrypted audit report. This combination of metering of the creation of permissions records; secure, encrypted audit information reporting processes; secure VDE subsystem reconciliation of metering information reflecting the creation of registration and/or audit reporting permissions with received audit report detail; and one or more secure VDE installation expiration and/or other termination and/or other consequence processes; taken together significantly enhances the integrity of the VDE secure audit reporting process as a trusted, efficient, commercial environment.

example, a content user 112 generally can't change "rules and controls" specified by a distributor 106 that require the user to pay for content usage at a certain rate. "Rules and controls" may "persist" as they pass through a "chain of handling and control," and may be "inherited" as they are passed down from one VDE participant to the next.

Depending upon their needs, VDE participants can specify that their "rules and controls" can be changed under conditions specified by the same or other "rules and controls." For example, "rules and controls" specified by the content creator 102 may permit the distributor 106 to "mark up" the usage price just as retail stores "mark up" the wholesale price of goods. Figure 2A shows an example in which certain "rules and controls" persist unchanged from content creator 102 to content user 112; other "rules and controls" are modified or deleted by distributor 106; and still other "rules and controls" are added by the distributor.

"Rules and controls" can be used to protect the content user's privacy by limiting the information that is reported to other VDE participants. As one example, "rules and controls" can cause content usage information to be reported anonymously

information. Performing this tagging "change" frequently (for example, every time a given record is decrypted) prevents the substitution of "incorrect" information for "correct" information, since said substitution will not carry information which will match the tagging information stored within the hardware SPE during subsequent retrieval of the information.

Another benefit of information tagging is the use of tags to help enforce and/or verify information and/or control mechanisms in force between two or more parties. If information is tagged by one party, and then passed to another party or parties, a tag can be used as an expected value associated with communications and/or transactions between the two parties regarding the tagged information. For example, if a tag is associated with a data element that is passed by Party A to Party B, Party B may require Party A to prove knowledge of the correct value of at least a portion of a tag before information related to, and/or part of, said data element is released by Party B to Party A, or vice versa. In another example, a tag may be used by Party A to verify that information sent by Party B is actually associated with, and/or part of, a tagged data element, or vice versa.

Establishing A Secure, Authenticated, Communication Channel

From time to time, two parties (e.g., PPEs A and B), will need to establish a communication channel that is known by both

parties to be secure from eavesdropping, secure from tampering, and to be in use solely by the two parties whose identifies are correctly known to each other.

The following describes an example process for establishing such a channel and identifies how the requirements for security and authentication may be established and validated by the parties. The process is described in the abstract, in terms of the claims and belief each party must establish, and is not to be taken as a specification of any particular protocol. In particular, the individual sub-steps of each step are not required to be implemented using distinct operations; in practice, the establishment and validation of related proofs is often combined into a single operation.

The sub-steps need not be performed in the order detailed below, except to the extent that the validity of a claim cannot be proven before the claim is made by the other party. The steps may involve additional communications between the two parties than are implied by the enumerated sub-steps, as the "transmission" of information may itself be broken into sub-steps. Also, it is not necessary to protect the claims or the proofs from disclosure or modification during transmission. Knowledge of the claims (including the specific communication proposals and acknowledgements thereof) is not considered protected

information. Any modification of the proofs will cause the proofs to become invalid and will cause the process to fail.

Standard public-key or secret-key cryptographic techniques can be used to implement this process (e.g., X.509, Authenticated Diffie-Hellman, Kerberos). The preferred embodiment uses the three-way X.509 public key protocol steps.

The following may be the first two steps in the example process:

- A. (*precursor step*): Establish means of creating validatable claims by A
- B. (*precursor step*): Establish means of creating validatable claims by B

These two steps ensure that each party has a means of making claims that can be validated by the other party, for instance, by using a public key signature scheme in which both parties maintain a private key and make available a public key that itself is authenticated by the digital signature of a certification authority.

The next steps may be:

A (proposal step):

1. Determine B's identity

2. Acquire means of validating claims made by B
3. Create a unique identity for this specific proposed communication
4. Create a communication proposal identifying the parties and the specific communication
5. Create validatable proof of A's identity and the origin of the communication proposal
6. Deliver communication proposal and associated proof to B.

These steps establish the identity of the correspondent party B and proposes a communication. Because establishment of the communication will require validation of claims made by B, a means must be provided for A to validate such claims. Because the establishment of the communication must be unique to a specific requirement by A for communication, this communication proposal and all associated traffic must be unambiguously distinguishable from all other such traffic. Because B must validate the proposal as a legitimate proposal from A, a proof must be provided that the proposal is valid.

The next steps may be as follows:

B (acknowledgement step):

1. Extract A's identity from the communication proposal
2. Acquire means of validating claims made by A
3. Validate A's claim of identity and communication proposal origin
4. Determine the unique identification of the communication proposal
5. Determine that the communication proposal does not duplicate an earlier proposal
6. Create an acknowledgement identifying the specific communication proposal
7. Create validatable proof of B's identity and the origin of the acknowledgement
8. Deliver the acknowledgement and associated proof to A.

These steps establish that party B has received A's communication proposal and is prepared to act on it. Because B must validate the proposal, B must first determine its origin and validate its authenticity. B must ensure that its response is associated with a specific proposal, and that the proposal is not a replay. If B accepts the proposal, it must prove both B's own identity and that B has received a specific proposal.

The next steps may be:

A (establishment step):

1. Validate B's claim acknowledgement of A's specific proposal
2. Extract the identity of the specific communication proposal from the acknowledgement
3. Determine that the acknowledgement is associated with an outstanding communication proposal
4. Create unique session key to be used for the proposed communication
5. Create proof of session key's creation by A
6. Create proof of session key's association with the specific communication proposal
7. Create proof of receipt of B's acknowledgement
8. Protect the session key from disclosure in transmission
9. Protect the session key from modification in transmission
10. Deliver protected session key and all proofs to B.

These steps allows A to specify a session key to be associated with all further traffic related to A's specific communication proposal. A must create the key, prove that A created it, and prove that it is associated with the specific proposed communication. In addition, A must prove that the

session key is generated in response to B's acknowledgement of the proposal. The session key must be protected from disclosure of modification to ensure that an attacker cannot substitute a different value.

Transportability of VDE Installations Between PPEs 650

In a preferred embodiment, VDE objects 300 and other secure information may if appropriate, be transported from one PPE 650 to another securely using the various keys outlined above. VDE 100 uses redistribution of VDE administrative information to exchange ownership of VDE object 300, and to allow the portability of objects between electronic appliances 600.

The permissions record 808 of VDE objects 300 contains rights information that may be used to determine whether an object can be redistributed in whole, in part, or at all. If a VDE object 300 can be redistributed, then electronic appliance 600 normally must have a "budget" and/or other permissioning that allows it to redistribute the object. For example, an electronic appliance 600 authorized to redistribute an object may create an administrative object containing a budget or rights less than or equal to the budget or rights that it owns. Some administrative objects may be sent to other PPEs 650. A PPE 650 that receives one of the administrative objects may have the ability to use at least a portion of the budgets, or rights, to related objects.

desire to acquire a new VDE object 300 will provide an incentive for users to update their PPEs 650 at regular time intervals.

Finally, the end-to-end nature of VDE applications, in which content 108 flows in one direction, generating reports and bills 118 in the other, makes it possible to perform "back-end" consistency checks. Such checks, performed in clearinghouses 116, can detect patterns of use that may or do indicate fraud (e.g., excessive acquisition of protected content without any corresponding payment, usage records without corresponding billing records). The fine grain of usage reporting and the ready availability of usage records and reports in electronic form enables sophisticated fraud detection mechanisms to be built so that fraud-related costs can be kept to an acceptable level.

PPE Initialization

Each PPE 650 needs to be initialized before it can be used. Initialization may occur at the manufacturer site, after the PPE 650 has been placed out in the field, or both. The manufacturing process for PPE 650 typically involves embedding within the PPE sufficient software that will allow the device to be more completely initialized at a later time. This manufacturing process may include, for example, testing the bootstrap loader and challenge-response software permanently stored within PPE 650, and loading the PPE's unique ID. These steps provide a

- a certain flat rate fee should apply to opening the periodical regardless of the number of articles opened, and/or
- a record should be maintained of every advertisement that is viewed by a user.

If content is maintained in a known and/or identifiable format, such a template may be used during initial construction of a container without author 3306A's intervention to identify any map tables that may be required to support such recording and billing actions. If such a VDE template is unavailable to author 3306A, she may choose to indicate that the container submitted should be reconstructed (e.g. augmented) by the repository to include the VDE control information specified in a certain template or class of templates. If the format of the content is known and/or identifiable by the repository, the repository may be able to reconstruct (or "complete") such a container automatically.

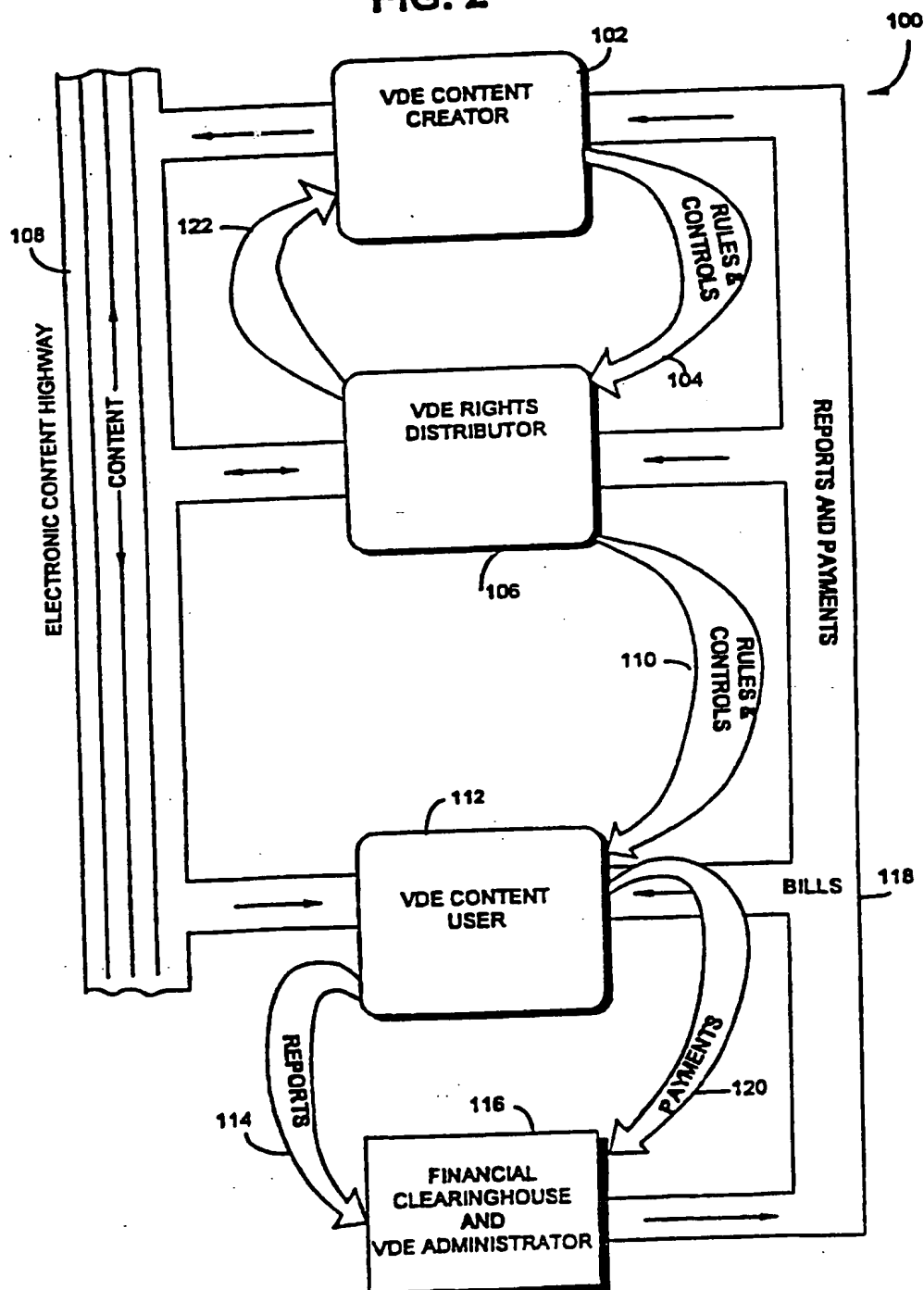
One factor in a potentially ongoing financial relationship between the repository and author 3306A may relate to usage of submitted content by end users 3310. For example, author 3306A may negotiate an arrangement with the repository wherein the repository is authorized to keep 20% of the total revenues generated from end users 3310 in exchange for

maintaining the repository services (e.g. making content available to end users 3310, providing electronic credit, performing billing activities, collecting fees, etc.) A financial relationship may be recorded in control structures in flexible and configurable ways. For example, the financial relationship described above could be created in a VDE container and/or installation control structure devised by author 3306A to reflect author 3306A's financial requirements and the need for a 20% split in revenue with the repository wherein all billing activities related to usage of submitted content could be processed by the repository, and control structures representing reciprocal methods associated with various component assemblies required for use of author 3306A's submitted content could be used to calculate the 20% of revenues. Alternatively, the repository may independently and securely add and/or modify control structures originating from author 3306A in order to reflect an increase in price. Under some circumstances, author 3306A may not be directly involved (or have any knowledge of) the actual price that the repository charges for usage activities, and may concern herself only with the amount of revenue and character of usage analysis information that she requires for her own purposes, which she specifies in VDE control information which governs the use, and consequences of use, of VDE controlled content.

Another aspect of the relationship between authors and the repository may involve the character of transaction recording requirements associated with delivery of VDE controlled content and receipt of VDE controlled content usage audit information. For example, author 3306A may require that the repository make a record of each user that receives a copy of content from the repository. Author 3306A may further require collection of information regarding the circumstances of delivery of content to such users (e.g. time, date, etc.) In addition, the repository may elect to perform such transactions for use internally (e.g. to determine patterns of usage to optimize systems, detect fraud, etc.)

In addition to recording information regarding delivery of such VDE controlled content, author 3306A may have required or requested the repository to perform certain VDE container related processes. For example, author 3306A may want differing abstract and/or other descriptive information delivered to different classes of users. In addition, author 3306A may wish to deliver promotional materials in the same container as submitted content depending on, for example, the character of usage exhibited by a particular user (e.g. whether the user has ever received content from author 3306A, whether the user is a regular subscriber to author 3306A's materials, and/or other patterns that may be relevant to author 3306A and/or the end

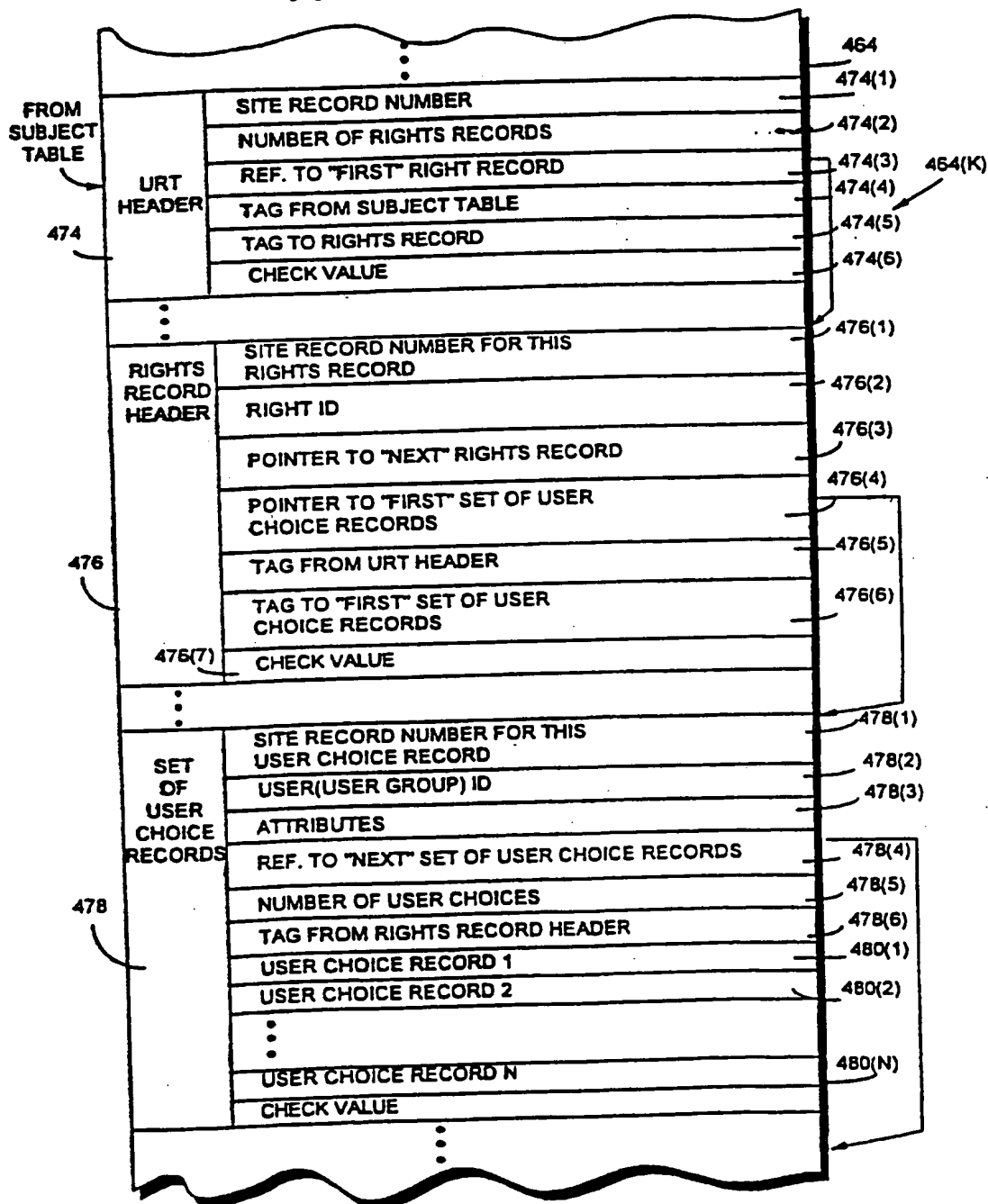
FIG. 2



validate the lookup to the rights record header 476, and a check value field 474(6).

Rights record header 476 in the preferred embodiment may include site record number field 476(1), a right ID field 476(2), a field 476(3) referencing the "next" rights record 476(2), a field 476(4) referencing a first set of user choice records 478(1), a tag 476(5) to allow validation with URT header tag 474(5), a tag 476(6) to allow validation with a user choice record tag 478(6), and a check value field 476(7). Right ID field 476(2) may, for example, specify the type of right conveyed by the rights record 476(e.g., right to use, right to distribute, right to read, right to audit, etc.).

The one or more user choice records 478 referenced by rights record header 476 sets forth the user choices corresponding to access and/or use of the corresponding VDE object 300. There will typically be a rights record 476 for each right authorized to the corresponding user or user group. These rights govern use of the VDE object 300 by that user or user group. For instance, the user may have an "access" right, and an "extraction" right, but not a "copy" right. Other rights controlled by rights record 476 (which is derived from PERC 808 using a REGISTER method in the preferred embodiment) include distribution rights, audit rights, and pricing rights. When an

FIG. 33 USER RIGHTS TABLE

the same sense as the global certification keys 2811, 2813, and 2814, or they may be restricted to use within a defined group of VDE instances.

To perform this installation, the installer retrieves the destination site's identity certificate(s) 2823, and from that extracts the site public key(s) 2815. These key(s) may be used in an encryption process 2841 to protect the keys being installed. The key(s) being installed are then transmitted inside the destination site's PPE 650. Inside the PPE 650, the decryption process 2842 may use the site private key(s) 2816 to decrypt the transmission. The PPE 650 then stores the installed or updated keys in its key storage 2802.

Object-Specific Key Use

Figures 66 and 67 illustrate the use of keys in protecting data and control information associated with VDE objects 300.

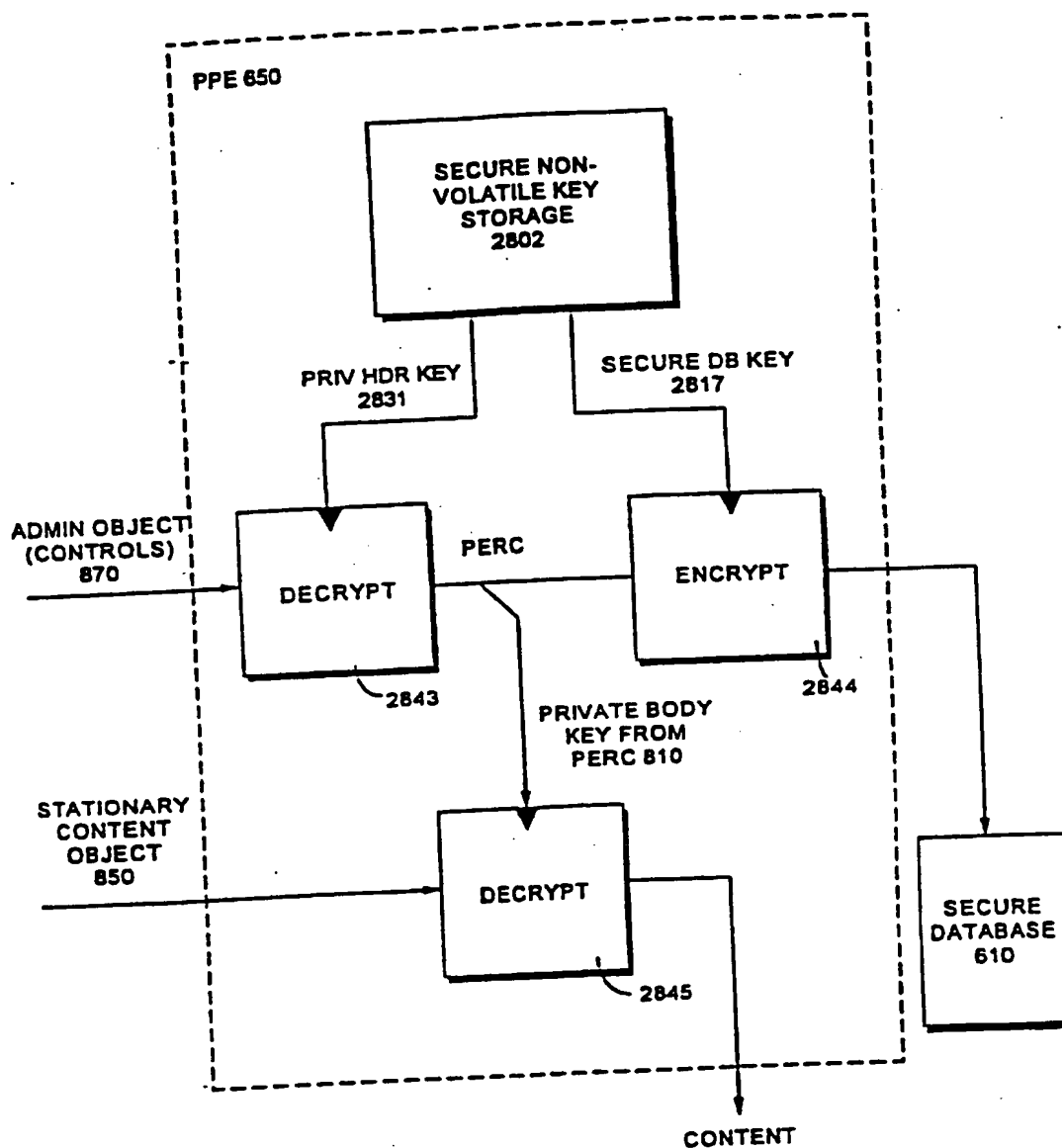
Figure 66 shows use of a stationary content object 850 whose control information is derived from an administrative object 870. The objects may be received by the PPE 650 (e.g., by retrieval from an object repository 728 over a network or retrieved from local storage). The administrative object decryption process 2843 may use the private header key(s) 2815 to decrypt the administrative object 870, thus retrieving the

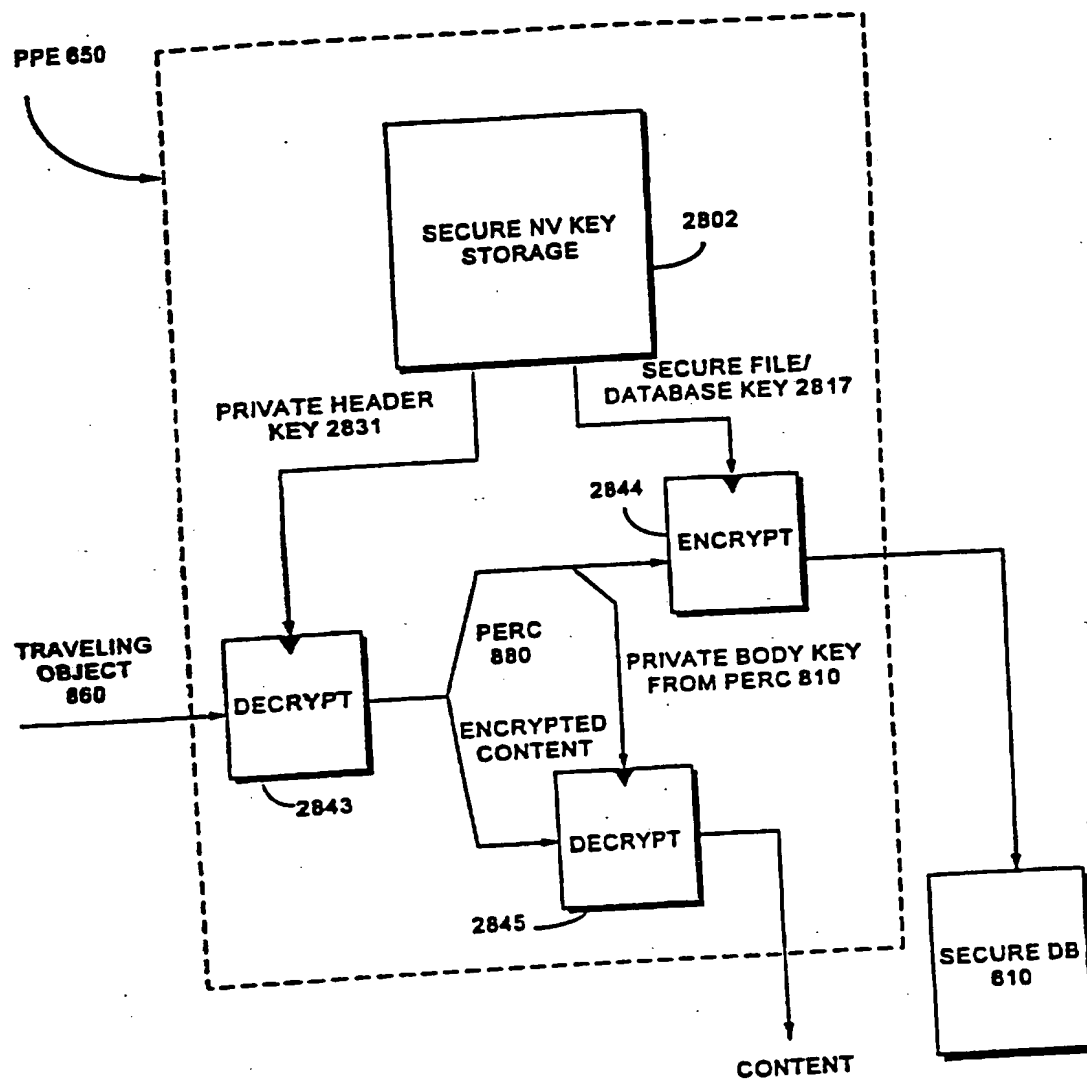
PERC 808 governing access to the content object 850. The private body key(s) 810 may then be extracted from the PERC 808 and used by the content decryption process 2845 to make the content available outside the PPE 650. In addition, the database key(s) 2817 may be used by the encryption process 2844 to prepare the PERC for storage outside the PPE 650 in the secure database 610. In subsequent access to the content object 850, the PERC 808 may be retrieved from the secure database 610, decrypted with database key(s) 2817, and used directly, rather than being extracted from administrative object 870.

Figure 67 shows the similar process involving a traveling object 860. The principal distinction between Figures 66 and 67 is that the PERC 808 is stored directly within the traveling object 860, and therefore may be used immediately after the decryption process 2843 to provide a private header key(s) 2831. This private header key 2831 is used to process content within the traveling object 860.

Secret-Key Variations

Figures 64 through 67 illustrate the preferred public-key embodiment, but may also be used to help understand the secret-key versions. In secret-key embodiments, the certification process and the public key encryptions/decryptions are replaced with private-key encryptions, and the public key/private-key

**FIG. 66** STATIONARY OBJECT DECRYPTION

**FIG. 67** TRAVELING OBJECT DECRYPTION

Cryptographic Sealing

Sealing is used to protect the integrity of information when it may be subjected to modifications outside the control of the PPE 650, either accidentally or as an attack on the VDE security. Two specific applications may be the computation of check values for database records and the protection of data blocks that are swapped out of an SPE 500.

There are two types of sealing: keyless sealing, also known as cryptographic hashing, and keyed sealing. Both employ a cryptographically strong hash function, such as MD5 or SHA. Such a function takes an input of arbitrary size and yields a fixed-size hash, or "digest." The digest has the property that it is infeasible to compute two inputs that yield the same digest, and infeasible to compute one input that yields a specific digest value, where "infeasible" is with reference to a work factor based on the size of the digest value in bits. If, for example, a 256-bit hash function is to be called strong, it must require approximately on average 10^{38} (2^{128}) trials before a duplicated or specified digest value is likely to be produced.

Keyless seals may be employed as check values in database records (e.g., in PERC 808) and similar applications. A keyless seal may be computed based on the content of the body of the record, and the seal stored with the rest of the record. The

combination of seal and record may be encrypted to protect it in storage. If someone modifies the encrypted record without knowing the encryption key (either in the part representing the data or the part representing the seal), the decrypted content will be different, and the decrypted check value will not match the digest computed from the record's data. Even though the hash algorithm is known, it is not feasible to modify both the record's data and its seal to correspond because both are encrypted.

Keyed seals may be employed as protection for data stored outside a protected environment without encryption, or as a validity proof between two protected environments. A keyed seal is computed similarly to a keyless seal, except that a secret initial value is logically prefixed to the data being sealed. The digest value thus depends both on the secret and the data, and it is infeasible to compute a new seal to correspond to modified data even though the data itself is visible to an attacker. A keyed seal may protect data in storage with a single secret value, or may protect data in transit between two environments that share a single secret value.

The choice of keys or keyless seals depends on the nature of the data being protected and whether it is additionally protected by encryption.

Arrow 104 shows the content creator 102 sending the "rules and controls" associated with the content to a VDE rights distributor 106 ("distributor") over an electronic highway 108 (or by some other path such as an optical disk sent by a delivery service such as U. S. mail). The content can be distributed over the same or different path used to send the "rules and controls." The distributor 106 generates her own "rules and controls" that relate to usage of the content. The usage-related "rules and controls" may, for example, specify what a user can and can't do with the content and how much it costs to use the content. These usage-related "rules and controls" must be consistent with the "rules and controls" specified by content creator 102.

Arrow 110 shows the distributor 106 distributing rights to use the content by sending the content's "rules and controls" to a content user 112 such as a consumer. The content user 112 uses the content in accordance with the usage-related "rules and controls."

In this Figure 2 example, information relating to content use is, as shown by arrow 114, reported to a financial clearinghouse 116. Based on this "reporting," the financial

clearinghouse 116 may generate a bill and send it to the content user 112 over a "reports and payments" network 118. Arrow 120 shows the content user 112 providing payments for content usage to the financial clearinghouse 116. Based on the reports and payments it receives, the financial clearinghouse 116 may provide reports and/or payments to the distributor 106. The distributor 106 may, as shown by arrow 122, provide reports and/or payments to the content creator 102. The clearinghouse 116 may provide reports and payments directly to the creator 102. Reporting and/or payments may be done differently. For example, clearinghouse 116 may directly or through an agent, provide reports and/or payments to each of VDE content creators 102, and rights distributor 106, as well as reports to content user 112.

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The distributor 106 and the content creator 102 may be the same person, or they may be different people. For example, a musical performing group may act as both content creator 102 and distributor 106 by creating and distributing its own musical recordings. As another example, a publishing house may act as a distributor 106 to distribute rights to use works created by an author content creator 102. Content creators 102 may use a

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Updating Secure Database 610

Figure 35 show an example of a process 1150 which can be used by a clearinghouse, VDE administrator or other VDE participant to update the secure database 610 maintained by an end user's electronic appliance 600. For example, the process 1500 shown in Figure 35 might be used to collect "audit trail" records within secure database 610 and/or provide new budgets and permissions (e.g., PERCs 808) in response to an end user's request.

Typically, the end user's electronic appliance 600 may initiate communications with a clearinghouse (Block 1152). This contact may, for example, be established automatically or in response to a user command. It may be initiated across the electronic highway 108, or across other communications networks such as a LAN, WAN, two-way cable or using portable media exchange between electronic appliances. The process of exchanging administrative information need not occur in a single "on line" session, but could instead occur over time based on a number of different one-way and/or two-way communications over the same or different communications means. However, the process 1150 shown in Figure 35 is a specific example where the end user's electronic appliance 600 and the other VDE participant (e.g., a clearinghouse) establish a two-way real-time

interactive communications exchange across a telephone line, network, electronic highway 108, etc.

The end user's electronic appliance 600 generally contacts a particular VDE administrator or clearinghouse. The identity of the particular clearinghouse is based on the VDE object 300 the user wishes to access or has already accessed. For example, suppose the user has already accessed a particular VDE object 300 and has run out of budget for further access. The user could issue a request which will cause her electronic appliance 600 to automatically contact the VDE administrator, distributor and/or financial clearinghouse that has responsibility for that particular object. The identity of the appropriate VDE participants to contact is provided in the example by information within UDEs 1200, MDEs 1202, the Object Registration Table 460 and/or Subject Table 462, for example. Electronic appliance 600 may have to contact multiple VDE participants (e.g., to distribute audit records to one participant, obtain additional budgets or other permissions from another participant, etc.). The contact 1152 may in one example be scheduled in accordance with the Figure 27 Shipping Table 444 and the Figure 29 Administrative Event Log 442.

Once contact is established, the end user's electronic appliance and the clearinghouse typically authenticate one

another and agree on a session key to use for the real-time information exchange (Block 1154). Once a secure connection is established, the end user's electronic appliance may determine (e.g., based on Shipping Table 444) whether it has any administrative object(s) containing audit information that it is supposed to send to the clearinghouse (decision Block 1156). Audit information pertaining to several VDE objects 300 may be placed within the same administrative object for transmission, or different administrative objects may contain audit information about different objects. Assuming the end user's electronic appliance has at least one such administrative object to send to this particular clearinghouse ("yes" exit to decision Block 1156), the electronic appliance sends that administrative object to the clearinghouse via the now-established secure real-time communications (Block 1158). In one specific example, a single administrative object may be sent an administrative object containing audit information pertaining to multiple VDE objects, with the audit information for each different object compromising a separate "event" within the administrative object.

The clearinghouse may receive the administrative object and process its contents to determine whether the contents are "valid" and "legitimate." For example, the clearinghouse may analyze the contained audit information to determine whether it indicates misuse of the applicable VDE object 300. The

clearinghouse may, as a result of this analysis, may generate one or more responsive administrative objects that it then sends to the end user's electronic appliance 600 (Block 1160). The end user's electronic appliance 600 may process events that update its secure database 610 and/or SPU 500 contents based on the administrative object received (Block 1162). For example, if the audit information received by the clearinghouse is legitimate, then the clearinghouse may send an administrative object to the end user's electronic appliance 600 requesting the electronic appliance to delete and/or compress the audit information that has been transferred. Alternatively or in addition, the clearinghouse may request additional information from the end-user electronic appliance 600 at this stage (e.g., retransmission of certain information that was corrupted during the initial transmission, transmission of additional information not earlier transmitted, etc.). If the clearinghouse detects misuse based on the received audit information, it may transmit an administrative object that revokes or otherwise modifies the end user's right to further access the associated VDE objects 300.

The clearinghouse may, in addition or alternatively, send an administrative object to the end user's electronic appliance 600 that instructs the electronic appliance to display one or more messages to the user. These messages may inform the user about certain conditions and/or they may request additional

information from the user. For example, the message may instruct the end user to contact the clearinghouse directly by telephone or otherwise to resolve an indicated problem, enter a PIN, or it may instruct the user to contact a new service company to re-register the associated VDE object. Alternatively, the message may tell the end user that she needs to acquire new usage permissions for the object, and may inform the user of cost, status and other associated information.

During the same or different communications exchange, the same or different clearinghouse may handle the end user's request for additional budget and/or permission pertaining to VDE object 300. For example, the end user's electronic appliance 600 may (e.g., in response to a user input request to access a particular VDE object 300) send an administrative object to the clearinghouse requesting budgets and/or other permissions allowing access (Block 1164). As mentioned above, such requests may be transmitted in the form of one or more administrative objects, such as, for example, a single administrative object having multiple "events" associated with multiple requested budgets and/or other permissions for the same or different VDE objects 300. The clearinghouse may upon receipt of such a request, check the end user's credit, financial records, business agreements and/or audit histories to determine whether the requested budgets and/or permissions should be given. The

clearinghouse may, based on this analysis, send one or more responsive administrative objects which cause the end user's electronic appliance 600 to update its secure database in response (Block 1166, 1168). This updating might, for example, comprise replacing an expired PERC 808 with a fresh one, modifying a PERC to provide additional (or lesser) rights, etc. Steps 1164-1168 may be repeated multiple times in the same or different communications session to provide further updates to the end user's secure database 610.

Figure 36 shows an example of how a new record or element may be inserted into secure database 610. The load process 1070 shown in Figure 35 checks each data element or item as it is loaded to ensure that it has not been tampered with, replaced or substituted. In the process 1070 shown in Figure 35, the first step that is performed is to check to see if the current user of electronic appliance 600 is authorized to insert the item into secure database 610 (block 1072). This test may involve, in the preferred embodiment, loading (or using already loaded) appropriate methods 1000 and other data structures such as UDEs 1200 into an SPE 503, which then authenticates user authorization to make the change to secure database 610 (block 1074). If the user is approved as being authorized to make the change to secure database 610, then SPE 503 may check the integrity of the element to be added to the secure database by

FIG. 35

